

REMARKS

A final Office Action was mailed on December 10, 2003. Claims 1 – 18 are pending in the present application. Applicants amend claims 1, 7, 13 and 16. No new matter is introduced. Support for the amendments may be found, for example, in Applicants' specification at page 21, line 6 through page 22, line 18.

REJECTIONS UNDER 35 U.S.C. § 102

Claims 1 - 18 are rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 5,963,896 to Ozawa. Applicants amend claims 1, 7, 13 and 16 to further clarify the nature of their invention, and respectfully traverse this rejection.

Applicants' claimed invention (for example, as claimed in independent claims 1, 7, 13 and 16) discloses a speech coding and decoding method and apparatus that involves the vector-quantization of the analysis-by-synthesis type, using a configuration variable code book. Each of the code words contained in the configuration variable code book is constituted only from a plurality of non-zero amplitude values. Sample positions associated with the non-zero amplitude values are variably replaced using both an index i and a transmission parameter ρ which represents a feature amount of voice. The transmission parameter may be constituted by a lag value corresponding to a pitch period, or alternatively, by a pitch gain value. Replacements to a position of a sample of the non-zero amplitude value in the configuration variable code book are made using only an index and a transmission parameter indicating a feature amount of voice without any additional supplementary information. The position and amplitude of the non-zero amplitude values coding an input speech signal are selected as an optimum series from among entries in the configuration variable codebook, which entries are varied by a certain rule rather than being determined as a function of the input speech

signal. In addition, such that the number of non-zero amplitude values coding an input speech signal remains constant even if one or more of a lag value and a frame length of the input speech signal change.

For example, Applicants further disclose means by which the number of bits required to encode a sample is invariant with respect to lag value (see, e.g., pages 23 – 26 of Applicants' specification). Applicants' invention accomplishes this result by generating codes having non-zero bit positions selected from among a fixed number of eligible bit positions, where the eligible bit positions vary according to lag value (see, e.g., Applicants' FIGs. 10A – 10C).

According to Ozawa, an adaptive code book is configured to conduct pitch prediction by computing a pitch prediction signal and obtaining a delay that corresponds to a pitch period of the input speech signal. In particular, according to Fig. 1 of Ozawa, the adaptive code book circuit 300 receives the past excitation signal $V(n)$ from the weighting signal calculator 360, the output signal $x_w(n)$ from the subtracter 235 and the perceptually weighted impulse response $K_w(n)$ from the impulse response calculator 310 and determines the value of T at which the distortion D_T of the following equation becomes the minimum as delay T that corresponds to the pitch period.

$$D_T = \sum_{n=0}^{N-1} x_w'^2(n) - \frac{\left[\sum_{n=0}^{N-1} x_w'(n) y_w(n-T) \right]^2}{\sum_{n=0}^{N-1} y_w^2(n-T)}$$

Here, $y_w(n-T) = v(n-T) * h_w(n)$ represents a pitch prediction signal and the symbol $*$ represents a convolution operation. The gain β is expressed as follows.

$$\beta = \frac{\sum_{n=0}^{N-1} x_w'(n) y_w(n-T)}{\sum_{n=0}^{N-1} y_w^2(n-T)}$$

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The adaptive codebook circuit 300 conducts the pitch prediction from the obtained delay and gain by the following equation and output the prediction error signal $z_w(n)$ to the excitation quantizer 350.

$$z_w(n) = x'_w(n) - \beta v(n-T) * h_w(n)$$

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In contrast to the method of Ozawa, according to Applicants' claimed invention, configuration variable codebook 1 or 1' shown in Figs. 5 or 6 is an algebraic code book that generates code vectors each comprising a plurality of non-zero sample values, and is further capable of re-configuring itself by changing positions of non-zero samples in accordance to an index i and a transmission parameter p such as a pitch period (a lag value). Configuration variable codebook 1 or 1' of Applicants' claimed invention changes in terms of the non-zero sample positions, but importantly and unlike Ozawa, does not change in respect to the number of the non-zero samples. As a result of this, the bit number required for transmitting a code vector index does not have to be increased with a change made in terms of the non-zero sample positions. Applicants' coder and decoder are further discussed with reference to Figs. 5 – 8 of Applicants' drawing.

In regard to a coder that is configured in a manner shown in Fig. 5 of the present invention, the configuration variable codebook 1, after adjusting non-zero sample positions based on index i and transmission parameter p , outputs a code vector C_i , which is multiplied with a gain g at the gain unit 2. Then the linear prediction synthesis filter 3 receives the result of the multiplication and outputs a reproduced signal gAC_i . The subtracter 4 deducts the reproduced signal gAC_i from the input signal X and outputs the variance that result, which is an error signal E . The error power evaluation unit 5 computes an error power from the error signal E .

The above process is performed for all the code vectors C_i that are output from the configuration variable codebook 1, and also for all the varieties of the gain g to determine a pair of values, the index i of the code vector C_i and the gain variety, with which the associated error power is the smallest. Then, determined pairs of these values are transmitted to a decoder.



In regard to a decoder that is configured in a manner shown in Fig. 6, the parameter separation unit 6 obtains respective parameters contained in the data received from the coder. The configuration variable codebook 1' outputs a code vector C_i , based on the index i and the transmission parameter p , among parameters obtained by the parameter separation unit 6. The gain unit 2', then multiplies the gain g , which is another one of the parameters obtained by the parameter separation unit 6 to the code vector C_i . The linear prediction synthesis filter 3' receives the result of multiplication and outputs the reproduction signal gAC_i . Linear prediction parameters, while not shown in Fig. 6, are input to the linear prediction synthesis filter 3' from the parameter separation unit 6.

The configuration variable codebook 11 or 11' in Fig.7 or 8 is constituted from a pair of a non-zero sample position control unit 16, which receives an index i and a transmission parameter, a pitch period (a lag value) l , and a pitch emphasis filter 17, which receives a signal output from the non-zero sample position control unit 16 and the pitch period (the lag value) l . The non-zero sample position control unit 16 controls the positions of non-zero samples so that they are changed accordingly to the pitch period (the lag value) l , without changing the number of the non-zero samples. In doing this control, the non-zero sample position control unit 16 firstly distributes non-zero samples within an area corresponding to the lag value. At the same time, the non-zero sample position control unit 16 controls the manner of positioning the non-zero samples in which the non-zero samples positioned in a portion of the area corresponding to a lag value larger than the half of the frame length is reduced in number, where an effect of a recursive process performed by the pitch emphasis filter 17 is smaller, in a case in which the length indicated by the lag value is longer than half the length of the frame length. As a result of having this manner of non-zero sample position control, it becomes possible to keep the non-zero samples to a constant number irrespective to changes in the lag value



and the frame length, and hence avoid a situation in which the bit number required for transmitting a code vector index increases.

As reviewed above, an adaptive codebook as disclosed by Ozawa is configured to conduct pitch prediction by computing a pitch prediction signal and obtaining a delay that corresponds to a pitch period of the input speech signal. In sharp contrast, a configuration variable codebook as disclosed by Applicants is capable of re-configuring itself by changing the non-zero sample positions based on an index i and a transmission parameter p such as a pitch period (a lag value). The configuration variable codebook changes the positions of non-zero samples but does not change the number of them. As result, the bit number required for transmitting a code vector index does not have to be increased, for example, with added frame length.

Ozawa teaches digitizing sounds of a speech without degrading the associated sound-quality, offers a configuration in which an excitation quantizer 350 determines the most optimum set of positions for M non-zero pulses of which the vibration amplitudes are obtained, and actually obtains the amplitudes of the M non-zero pulses. Fig.8 of Ozawa shows a block diagram of a speech coding apparatus, which determines and obtains the positions and amplitudes of these non-zero pulses, of which the pulse series, when converted back to a speech signal, gives the minimum deviation against the original speech signal. According to Ozawa, the positions and amplitudes of the non-zero amplitude pulses are determined for each of the received speech signals in a manner with which they are determined to be the most optimum for respective speech signals. In addition, unlike Applicants' claimed invention, information about both the non-zero pulse positions and their amplitudes needs to be quantized for transmission. It, therefore, becomes necessary to transmit certain supplementary information together with the quantized signal to enable decoding the pulse series at a receiver side.

In contrast, the present invention differs as follows. A non-zero amplitude pulse series is generated by the configuration variable codebook, which is determined in accordance with a rule that is set by another transmission parameter such as a pitch period value. The positions and amplitudes are not determined respectively for the received speech signals, but are selected as the most optimum series from entries in the configuration variable codebook, of which the contents are varied and optimized by a certain rule.

As a result of this configuration associated with the present invention, it is not required to transmit any supplementary information. The codebook configuration is varied based on only the correlation existing among data pieces ordinarily transmitted. This means that no bit-rate increase becomes necessary in association with changing positions of non-zero pulses when working with the configuration according to the present invention. An adaptive codebook such as is used by Ozawa is composed of a pulse series each corresponding to the excitation signal in a preceding frame, and thereby may not cause a configuration change in accordance with the methods of the present invention.

These claimed features are not disclosed or suggested by Ozawa. Accordingly, Applicants respectfully submit that claims 1, 7, 13 and 16 stand in condition for allowance. As claims 2 – 6, 8 – 12, 14 – 15 and 17- 18 each depend directly or indirectly from one of allowable claims 1, 7, 13 and 16, Applicants respectfully submit that claims 2 – 6, 8 – 12, 14 – 15 and 17- 18 are allowable for at least this reason.

Applicants respectfully submit that claims 2 – 6, 8 – 12, 14 – 15 and 17- 18 are allowable for an additional reason. Each of claims 2 – 6, 8 – 12, 14 – 15 and 17- 18 references specifying eligible non-zero bit positions in the codebook as a function lag value (see, e.g., pages 23 – 26 of Applicants' specification for description of associated means). Applicants respectfully submit that this claimed feature is not disclosed by



Ozawa. While Ozawa suggests that codebook entries may be related to a delay corresponding to pitch period, Ozawa fails to specifically disclose that eligible non-zero bit positions in the codebook are specified as a function of lag value.

CONCLUSION

An earnest effort has been made to be fully responsive to the Examiner's objections. In view of the above amendments and remarks, it is believed that claims 1 - 18, consisting of independent claims 1, 7, 13 and 16, and the claims dependent therefrom, are in condition for allowance. Passage of this case to allowance is earnestly solicited. However, if for any reason the Examiner should consider this application not to be in condition for allowance, he is respectfully requested to telephone the undersigned attorney at the number listed below prior to issuing a further Action.

Any fee due with this paper may be charged on Deposit Account 50-1290.

Respectfully submitted,



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